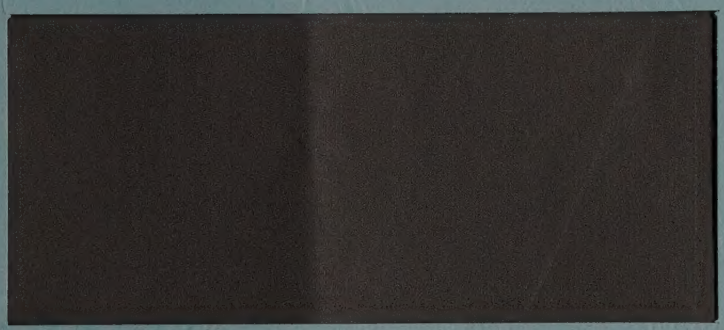
9/83

LORAIN

POWER EQUIPMENT



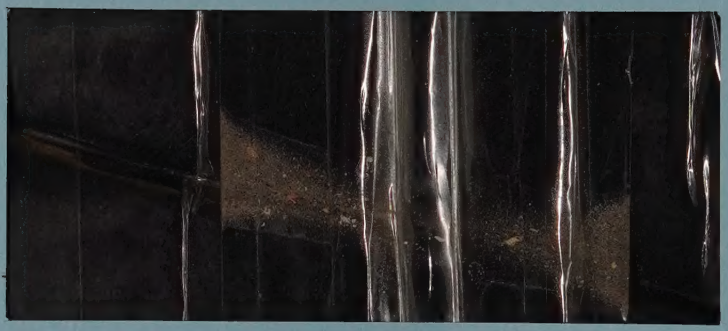
INSTRUCTIONS

INSTALLATION

OPERATION

MAINTENANCE

RELIANCE COMM/TEC



LORAIN MODEL HSB16A

DC TO DC CONVERTER

Spec. No. 5635-007 Serial No. _____

LORAIN PRODUCTS
Division of Reliance Electric Co.

WARRANTY

Seller warrants that the products it manufactures or sells shall be free from defects in material and workmanship during the first 90 days after the product is activated. During said period, Seller will repair or replace any defective parts free of charge to Buyer, including any labor costs. In addition, Seller shall repair or replace any defective parts, so discovered by Buyer to be defective within two years from the date of shipment of same, provided Buyer promptly so notifies Seller. In no case shall Seller's liability under this warranty extend beyond two years from the date of shipment of said product. This warranty shall not apply to any products which are misused, modified, repaired, or otherwise abused by Buyer or others. The repair or replacement of defective parts, or the refund of the invoice cost thereof, as shall be determined by Seller in its sole discretion, shall be the limit of Seller's liability hereunder and shall be Buyer's sole and exclusive remedy.

Handling or service charges in connection with the return of such products, if approved by Seller, shall be charged as determined by Seller. Seller shall not be liable in any event for any general or special, incidental or consequential damages to Buyer in excess of the amount of the purchase price of the products.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES. SELLER MAKES NO WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE WITH RESPECT TO ANY PRODUCTS EXCEPT AS HEREIN EXPRESSLY PROVIDED.

SYSTEMS AND EQUIPMENT NOT ECONOMICALLY RETURNABLE TO THE FACTORY

In the event that the product involved is a system or equipment which, in the judgement of Lorain Products, is not economically returnable to the factory or if Lorain Products has performed the installation, supervised the installation, or performed testing and turn-on, circuit components and Lorain repair labor are covered by this warranty for the first 90 days from date of turn-on and circuit components are warranted for two years from the date of shipment. Upon request, Lorain will send a service technician to the site to determine if the unit is defective in circuit components or workmanship, and will repair the equipment. If the failure is Lorain's fault, no invoice for circuit components or repair labor will be issued if the complaint has been issued within the first 90 days from date of turn-on. If the complaint is issued more than 90 days from the date of turn-on but within two years from date of shipment, the customer will be billed at the prevailing Customer Service rates but will not be billed for circuit components. If the problem occurs after two years from the date of shipment, circuit component and repair labor are billable.

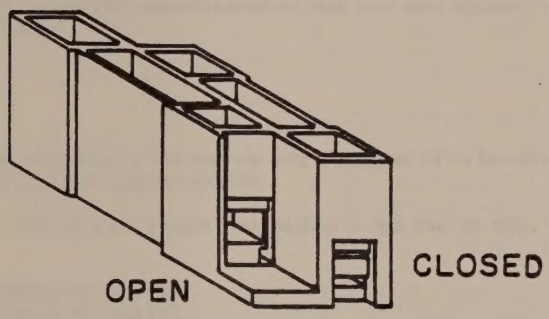
If the problem has been created by misuse or abuse of the equipment or by malfunction of associated equipment or by environmental conditions, at any time after shipment, the customer will be billed for circuit component and labor.

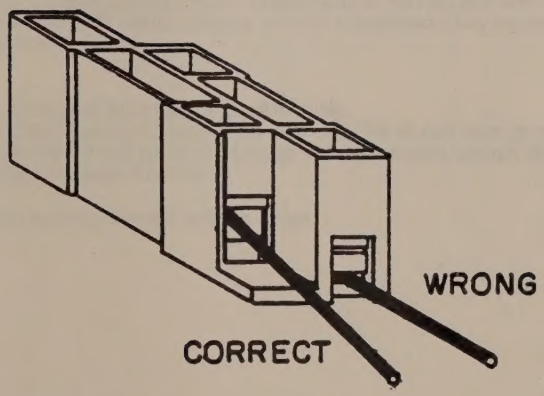
GENERAL PROVISIONS

Lorain Products shall not be obligated to pay any costs or charges incurred by the customer or by any other party. In no event will Lorain Products be liable for consequential damages. No waiver, alteration or modification of any of the provisions herein shall be binding on Lorain Products unless in writing and signed by an authorized official of Lorain Products. If, during any warranty period, the subject equipment has, in the opinion of Lorain Products, been modified or misrepaired, the warranty will be void unless the modifications or repairs have been made after consultation with Lorain Products and upon the recommendation of Lorain Products.

WARNING

When making electrical connections, assure that the wire is properly inserted between the metal clamps of the terminal (see sketch). Inserting the wire under the lower clamp of the terminal creates a potential fire hazard.





LORAIN PRODUCTS

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Productos Lorain de Mexico, S.A. de C.V., Apartado Postal 77001
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RELIANCE COMM/TEC

CLOSED

WRONG
CORRECT

1. SPECIFICATION

1.1 **GENERAL:** This DC to DC Converter changes 48 volts DC (positive ground) to 24 volts DC for either positive or negative grounded systems.

1.2 **OUTPUT RATINGS**

1.2.1 Voltage: Negative or positive 24 volts DC nominal. Adjustable over the range of 22.8 to 25.2 volts. An optional range is available; refer to paragraph 1.6.1.

1.2.2 Regulation
(A) Static: Steady state output voltage remains within ± 1% of the adjusted voltage for any load current from no load to full load for the input voltage range of 42 to 56 volts DC.

(B) Dynamic: For a step load change of 50% of full load within the range of 10% to 100% of full rated current, the maximum voltage transient will not exceed 5% of the initial steady state voltage. Refer to paragraph 1.8.1.

1.2.3 Filtering
(A) Voice Band: Noise is less than 26 dBrn C message. Refer to paragraph 1.8.1.

(B) Wide Band: Does not exceed 240 millivolts peak to peak over the frequency range of 10 Hz to 50 MHz. Refer to paragraph 1.8.1.

1.2.4 Current: 16 amperes

1.3 **INPUT RATINGS**

1.3.1 Voltage: 48 volts DC (positive ground) - Will operate over a range of 42 to 56 volts DC. Converter will tolerate a range of 40 to 60 volts DC with no adverse effects.

1.3.2 Filtering: Noise reflected back to a 100 ampere hour battery is less than 26 dBrn. Refer to paragraph 1.8.1.

1.3.3 Typical Input Currents
(A) No Load: 0.36 amperes at 48 volts DC
(B) Full Load: 9.9 amperes at 48 volts DC
(C) Does not exceed 11.9 amperes at maximum overload with the input voltage within the range of 42 to 56 volts DC.

1.4 **STANDARD FEATURES**

1.4.1 Input Protection
Undervoltage: Low battery voltage sensing circuit causes output voltage and current to be reduced to zero when the input voltage goes below 37 volts. Output current is automatically restored up to maximum overload when input voltage goes above 42 volts.

1.4.2 Output Protection
(A) Short Circuit: One 20 ampere Bussmann Type BAF fuse.
(B) Current Limiting: Circuit limits DC output current to 110% of full load at nominal input.
(C) Overvoltage: Voltage trip circuit breaker and high voltage sensing circuit disconnect the input voltage when the output voltage exceeds 25.2 volts.

1.4.3 Audible Noise: Operating frequency beyond audible range.

ISSUE	CHG. NO.	DESCRIPTION
9	183-7504	BP DEC 7 1982 ADDITIONAL ACCESS WIRING HOLE ADDED, DIMENSION CORRECTED 12-7-82
8	—	JUN 17 1980 PARA. 1.4.2 (B) QUALIFIED S.B.C. 7-10-80

REVISIONS

LORAIN PRODUCTS
A RELIANCE ELECTRIC COMPANY

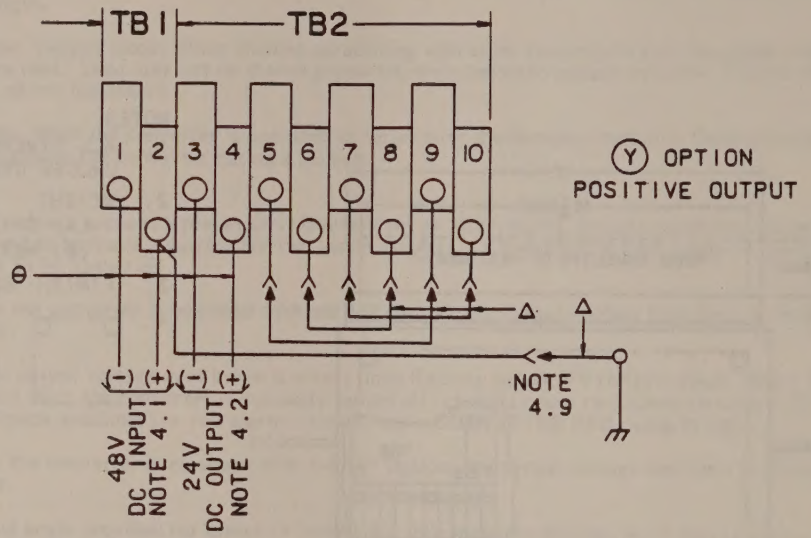
POWER DATA

MODEL HSB16A DC TO DC CONVERTER
SPEC. NO. 5635-007

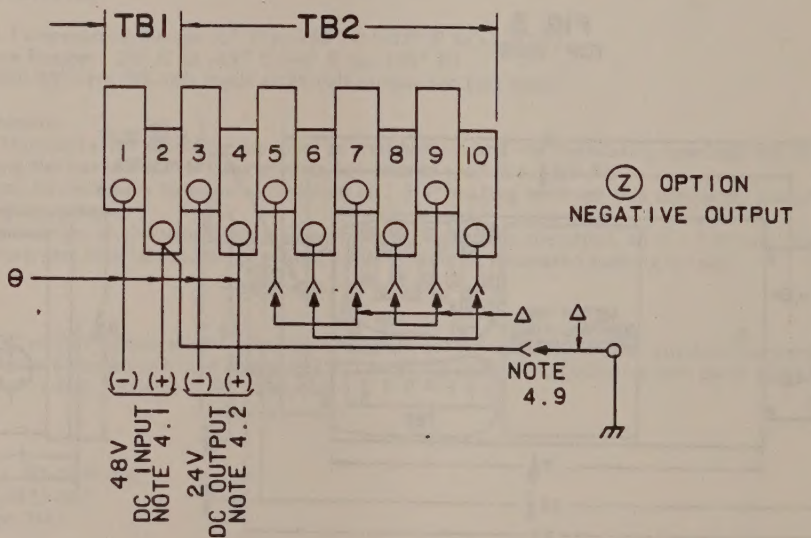
DR BY	DATE	GRP LDR.	DATE
S. Carrion	7-15-80	N. Kennedy	7-15-80
CH BY	DATE	APP BY	DATE
S. Carrion	7-15-80	R. Kunish	7-15-80
ENGR BY	DATE		
N. Kennedy	7-15-80		

PD-5635-007

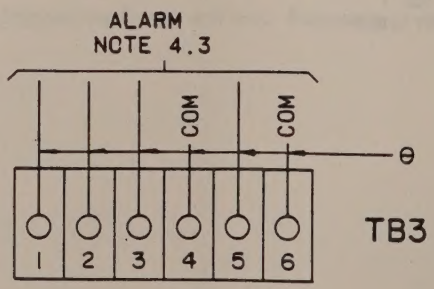
3. INSTALLER'S CONNECTIONS



Ⓨ OPTION
POSITIVE OUTPUT



Ⓩ OPTION
NEGATIVE OUTPUT



4. INSTALLER'S INFORMATION NOTES

4.1

DC INPUT (TB1)				
Terminals				
Capacity	Type	Loop Length - Ft	Recm Wire Size	Recm Fusing
22 to 8 Ga.	Saddle Clamp	50	12 Ga.	15 amperes
		100	8 Ga.	

4.2

DC OUTPUT (TB2)			
Terminals			
Capacity	Type	Loop Length - Ft	Recm Wire Size
22 to 8 Ga.	Saddle Clamp	90	8 Ga.

4.3

ALARMS (TB3)		
Terminals		
Capacity	Type	Recm Wire Size
16 Ga. Max.	6-32 Screw	18 Ga.

4.4 DC wire sizes are sufficient to restrict the voltage drop to one volt or less at full rated current for the loop lengths shown. The loop length is the sum of the positive and negative leads.

4.5 Wire sizes meet those recommended in the 1978 National Electric Code Table 310-16 for +75° C conductor temperature.

4.6 Alarm condition causes circuits to close between terminals 3 to 4 and 5 to 6 of terminal block TB3. Ground is also furnished at terminals 1 and 2 of terminal block TB3.

4.7 Δ indicates wiring furnished with the converter to be installed by the customer.

4.8 Θ indicates wiring furnished and installed by the customer.

4.9 Positive ground to chassis provided by jumper. Removal optional after installation.

LORAIN PRODUCTS CORP.
Operating Methods and
Circuit Description

"HSB" SERIES
DC TO DC CONVERTERS

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1. MODEL DATA

General

1.01 Refer to the appropriate Power Data Sheet for information concerning the input and output ratings, operating limits, dimensions, recommended input and output lead sizes, fusing, and terminal lug capacity for the following DC to DC Converters:

Model	Spec. No.
HSB3H	5664-022
HSB6H	5664-023
HSB8B	5653-027
HSB16A	5635-007
HSB16B	5653-028
HSB16B	5653-030
HSB30A	5645-002
HSB8A	5625-003

2. DESCRIPTION

General

2.01 This DC to DC Converter operates from nominal 48 volts DC to provide filtered and regulated DC to the load. This Converter is a compact unit designed with a high frequency switching circuit to maintain audible noise levels to an absolute minimum.

2.02 This Converter is equipped with a High Voltage Shutdown/Low Voltage Alarm circuit. In the event of a high output voltage condition, the Converter will shutdown; while a low output voltage condition will cause an alarm to be extended.

2.03 A low battery sensing circuit causes output voltage and current to be reduced to zero when the input voltage goes below 37 volts. Output current capability is restored up to maximum rated load when input voltage goes above 42 volts.

2.04 This Converter is also equipped with a current limiting circuit which will prevent further increase of output current above a preset (adjustable) level.

Accessories

2.05 An accessory for Model HSB16A (5653-007) is available for changing the output voltage adjustable range from 22.8 - 25.2 to 25.17 - 27.83. This option is designated "X" on Drawing SD-5635-0007.

2.06 An accessory for Model HSB30A (5645-002) is available for changing the output voltage adjustable range from 22.8 - 25.2 to 20.0 - 24.0 volts. This option is designated "X" on Drawing SD-5645-002.

3. INSTALLATION

Location

3.01 This DC to DC Converter will operate best in a well ventilated area which has an ambient temperature range of 0° C (32° F) to 50° C (122° F).

Mounting

3.02 This Converter is designed for mounting in 19 or 23 inch relay racks.

> CAUTION: In mounted position, ventilation openings at the top and bottom of the Converter cabinet must be unobstructed. This is essential for proper cooling during operation. The temperature of air entering the cabinet must not exceed 50° C (122° F). Refer to Power Data Sheet for spacing and baffle plate requirements.

Electrical Connections

3.03 Installer's input, output, and alarm connection terminals are accessible by removing the front cover of the unit. The terminal blocks are located at the front right side of the unit. Installer connections are shown on the Power Data Sheet.

4. ADJUSTMENT

General

4.01 All adjustment potentiometers are located on the plug-in circuit cards at the front left side of the unit. To gain access to the plug-in circuit cards, it is necessary to remove the front cover of the Converter.

Output Voltage Adjustment

4.02 The output voltage adjustment potentiometer OUTPUT VOLTAGE (R3), located on circuit card VR-A3, sets the output voltage level of the Converter. Unless otherwise specified, the output voltage has been factory adjusted to the output voltage given in Table A. Should readjustment become necessary, follow the procedure given below.

a) Adjust the output votlage to the desired level by means of potentiometer OUTPUT VOLTAGE (R3). The output voltage can be monitored on output voltmeter M1.

b) To increase output voltage, turn the screwdriver adjustment shaft of potentiometer R3 clockwise; to decrease output voltage, turn the adjustment shaft counterclockwise.

High Voltage Shutdown Adjustment

4.03 The high voltage shutdown adjustment potentiometer HIGH VOLTAGE SHUTDOWN (R2), located on circuit card HVS/LVA, sets the value of output voltage at which the Converter will shutdown. Unless otherwise specified, the high voltage shutdown limit has been factory adjusted to the voltage given in Table A. Should readjustment become necessary, follow the procedure given below.

> CAUTION
>
> It may be necessary to disconnect the load from the Converter output to perform this adjustment, since the Converter

Model & Spec.	Output Voltage Volts	Current Limit, %	High Voltage Shutdown, Volts	Low Voltage Alarm, Volts
HSB3H 5664-022	130	110	136-137	123-124
HSB6H 5664-023	130	110	136-137	123-124
HSB8B 5653-027	48	110	51.8-52.6	45.4-46.2
HSB16A 5635-007	24	110	25-25.4	22.6-23
HSB16A 5635-007 e/w "X" Option	26.5	110	26.6-28.0	25-25.4
HSB16B 5653-028 5653-030	48	110	51.8-52.6	45.4-46.2
HSB30A 5645-002	24	110	25-25.4	22.6-23
HSB30A 5645-002 e/w "X" Option	22	110	22.9-23.3	20.7-21.1
HSB8A 5625-003	24	110	25-25.4	22.6-23

TABLE A
FACTORY SETTINGS

will be shut off in the process.

a) Turn the screwdriver adjustment shaft of potentiometer HIGH VOLTAGE SHUTDOWN (R2) fully clockwise.

b) Increase the output voltage of the Converter to the desired shutdown value by turning clockwise the screwdriver adjustment shaft of potentiometer OUTPUT VOLTAGE (R3), located on circuit card VR-A3.

c) Turn the screwdriver adjustment shaft of potentiometer R2 counterclockwise until input circuit breaker CB1 opens.

d) Return potentiometer OUTPUT VOLTAGE (R3) to its original setting and close input circuit breaker CB1.

Low Voltage Alarm Adjustment

4.04 The low voltage alarm adjustment potentiometer LOW VOLTAGE ALARM (R1), located on circuit card HVS/LVA-A4, sets the value of output voltage at which the alarm circuits will illuminate lamp CONVERTER FAIL and activate an external alarm, if connected. Unless otherwise specified, the low voltage alarm limit has been factory adjusted to the value given in Table A. Should readjustment become necessary, follow the procedure given below.

a) Turn the screwdriver adjustment shaft of potentiometer LOW VOLTAGE ALARM (R1) fully counterclockwise.

b) Decrease the output voltage of the Converter to the desired alarm value by turning counterclockwise the screwdriver adjustment shaft of potentiometer OUTPUT VOLTAGE (R3), located on circuit card VR-A3.

c) Turn the screwdriver adjustment shaft of potentiometer R1 clockwise, slowly, until lamp CONVERTER FAIL illuminates.

d) Return potentiometer OUTPUT VOLTAGE (R3) to its original setting.

Gain Adjustment

4.05 The gain adjustment potentiometer GAIN ADJ (R3), located on circuit card DRV-A1, sets the Converter regulation control loop gain. This potentiometer has been factory set as required. Field adjustment is not recommended.

Low Battery Shutdown Adjustment

4.06 The Low Battery Shutdown Adjustment potentiometer (R28), located on circuit card DRV-A1, sets the value of input voltage at which the Converter will shutdown. This limit has been factory set at 37 volts DC. Field adjustment is not recommended.

Current Limit Adjustment

4.07 The current limit adjustment potentiometer (R30), located on circuit card DRV-A1, sets the value at which the output current limit circuit will prevent further increase of output current. This limit has been factory set at 110% of rated output current. Field adjustment is not recommended.

5. OPERATION

General

5.01 This DC to DC Converter operates from nominal 48 volts DC to provide filtered and regulated DC to the load. An output wiring option allows the user to select either positive or negative output. Since the Converter operates without moving parts, it requires no periodic maintenance or adjustment.

Starting and Stopping

5.02 To start or stop Converter operation, place circuit breaker CB1 in the ON or OFF position, respectively. The circuit breaker is located on the front panel directly below the meters.

Metering

5.03 This DC to DC Converter is equipped with an output voltmeter (M1) and ammeter (M2) which indicate output voltage and cur

rent, respectively.

Local Alarms

5.04 CONVERTER FAILURE: Lamp CONVERTER FAILURE (LED1) will illuminate during a high voltage shutdown, low voltage alarm, low battery shutdown, or converter output failure.

Remote Alarms

5.05 High Voltage Shutdown and Low Battery Shutdown: Terminals 3 to 4 and 5 to 6 provide closed circuits; while positive battery is provided at terminals 1 and 2 of terminal block TB3 during a high voltage shutdown condition. Circuit breaker CB1 must be reset manually by placing it in the ON position to resume operation. For a description of the low battery sensing circuit (shown on the schematic diagram as "low battery shutdown"), refer to Para. 2.03.

5.06 Low Voltage Alarm: Terminals 3 to 4 and 5 to 6 provide closed circuits; while positive battery is provided at terminals 1 and 2 of terminal block TB3 during a low voltage alarm condition.

Fuses

5.07 The following table lists the function, size, and type of each fuse used in this DC to DC Converter. If replacement becomes necessary, use the size and type listed, or equivalent.

Function	Size (Amps)	Type
F1 DC OUTPUT	20 HSB16A, HSB16B	Bussmann BAF
	40 HSB30A	Bussmann ABU
	10 HSB8A, HSB8B, HSB6H	Bussmann BAF
	5 HSB3H	Bussmann BAF

Component Boards

5.08 Any of the following component boards can easily be replaced as individual assemblies in the event of a failure of some component on a component board.

Component Boards

DRV-A1 (4338-365)	Driver Circuit
*DRV-A1 (4338-390)	Driver Circuit
PA-A2 (4337-325)	Power Amplifier Assembly
**PA-A2 (4337-039)	Power Amplifier Assembly
VR-A3 (4865-646)	Voltage Regulator Circuit
HVS/LVA-A4 (4863-760)	High Voltage Shutdown/Low Voltage Alarm Circuits

*In Models HSB8A (5625-003), HSB16A (5635-007), HSB30A (5645-002) only

**In Models HSB16B (5653-028 and 5653-030), HSB30A (5645-002), and HSB6H (5664-023) only.

6. CIRCUIT DESCRIPTION

General

6.01 The appropriate schematic diagram shows the electrical and functional circuits of these "HSB" Series DC to DC Converters.

Input Filter

6.02 Choke L1, diodes CR1 and CR2, and capacitors C1-C6 and C14 (or C16) form an input filter which will suppress any transient input voltages to the Converter.

Power Amplifier PA-A2 (4337-325)

6.03 A portion of the DC input is applied to the power amplifier assembly where the DC voltage is controlled by transistors Q1 and Q2, and is then applied to transformer T1.

6.04 Transistors Q1 and Q2 operate in a

switching mode amplifying a quasi square wave signal generated by the driver circuit card DRV-A1, described later. This amplified square wave is then applied to power transformer T1 primary. Resistors R1-R3, R16, capacitors C1-C3, and diodes CR1 and CR2 suppress voltage spikes across the collectors of transistors Q1 and Q2.

Power Amplifier PA-A2 (4337-039)

6.05 A portion of the DC input is applied to the power amplifier assembly where the DC voltage is controlled by transistors Q1-Q4, and is then applied to transformer T1.

6.06 Transistors Q1-Q4 operate in a switching mode amplifying a quasi square wave signal generated by the driver circuit card DRV-A1, described later. This amplified square wave is then applied to the power transformer T1 primary. Resistors R1-R3, R16, capacitors C1-C3, and diodes CR1 and CR2 suppress voltage spikes across the collectors of transistors Q1-Q4.

Output Circuit

6.07 The applied square wave of transformer T1 primary is induced on the power secondary windings of T1, which are connected to a rectifying network. This rectified DC voltage is then applied to the output terminals of the Converter.

6.08 The positive output is applied through inductor L2 while the negative output is applied through ammeter M2. If positive output is required, series diode CR3 and output fuse F1 will be in the positive line; likewise, if negative output is required, series diode CR3 and output fuse F1 will be in the negative line.

6.09 Series diode CR3 isolates the DC to DC Converter from any parallel connected Converters, thus preventing disturbance of bus voltage by a failed parallel connected Converter. Shunt diode CR6 (in some models) prevents complete loss of bus voltage in boost mode operation due to a failed Converter.

Driver Circuit DRV-A1 (4338-365 or 4338-390)

6.10 The driver circuit produces the quasi square wave which is applied alternately to the power transistors located in the power amplifier circuit described above.

6.11 Clock A1 generates a 40 KHz pulse which is applied to voltage/pulse width Converter A1 generating a ramp. The slope of the ramp is determined by the current through resistor R12. This current is proportional to the input battery voltage. The width of the pulse generated by the VPW Converter A1 is determined by the slope of the ramp, by transistor Q6, and by the conduction of photo-coupler Q1. Photo-coupler Q1 is controlled by the regulator circuit. Transistor Q6 is controlled by the instantaneous collector current in the power amplifier circuit. Flip-flop A2 generates a 20 KHz square wave from the pulse produced by clock A1. The clock pulse, VPW converter output, and the square wave are combined in NAND gate A3 to form two out-of-phase variable quasi square waves. The two quasi square waves and their complement are buffered by A4. The quasi-square waves are amplified by transistors Q2-Q5 which operate in a constant current mode while their complement is amplified by transistors Q7 and Q8 which operates as a clamp on transformer T1 primary. Diodes CR12-CR14 provide bias for the amplifier transistors and provide voltage for circuits A1-A4 operation. Windings 1, 2 and 3, 4 of transformer T1 provide base drive voltage; while winding 9, 10 of transformer T1 provides power to operate the regulator and alarm circuits.

6.12 Battery voltage is applied to a voltage divider consisting of resistor R26 and potentiometer R28. When the divider voltage increases sufficiently to overcome the voltage across zener diode CR17, transistor Q10 will conduct. Transistor Q10, conducting, will bias transistor Q9 off, thus allowing capacitor C13 to charge. When capacitor C13 becomes fully charged, the VPW Converter A1 will begin to deliver maximum pulse width, which will result in full output power of the Converter.

6.13 The output current of the Converter is detected by a current transformer, located in the power amplifier circuit, and converted to a voltage which is applied to diodes CR20-CR23. This rectified voltage is then applied across capacitor C6. When the charge across capacitor C6 exceeds the reference voltage of zener diode CR1 on mini-board (4337-040) which is located on the driver circuit card, transistor Q6 will begin to conduct. The conduction of transistor Q6 will reduce the conduction angle through diode CR18 and lower the clock frequency through diodes CR19 and resistor R19.

Voltage Regulator Circuit VR-A3 (4865-646)

6.14 The voltage regulator circuit monitors the output voltage of the Converter. The output of the voltage regulator provides the VPW Converter with the error signal which will control the output voltage.

6.15 Comparator A1G3 compares the signal developed across resistor R2 and potentiometer R3, which is proportional to the output voltage, to a reference voltage developed across zener diode CR3. The output of comparator A1G3 is applied through diode CR1 to drive a photo-coupler on the driver circuit card. Regulator A1G2 functions as a series regulator for the isolated supply voltage developed across capacitor C8 and supplies voltage to zener diode CR3 and the photo-coupler on DRV-A1. Diodes CR4-CR11 comprise alternate rectifiers for the 20 KHz power from the driver circuit and the output circuit.

High Voltage Shutdown Low Voltage Alarm HVS/LVA-A4 (4863-760)

6.16 The HVS/LVA-A4 circuit card monitors the DC output voltage of the Converter. The circuit card contains two circuits: one that will cause the Converter to shutdown due to a high output voltage, and one that will cause an alarm to be extended due to a low output voltage.

6.17 DC output voltage is applied across resistor R4 and potentiometer R2, which is adjusted for a high voltage shutdown level. When the output voltage increases, the reference voltage developed across zener diode CR3 will remain stable, thus this difference between the voltage across potentiometer R2 and zener diode CR3 will be detected by comparator A1G1. Comparator A1G1 will swing positive causing light sensitive transistor Q1 to stop conducting, biasing transistor Q2 off and Q3 on. Conduction of transistor Q3 will cause ground to be applied to the trip coil of circuit breaker CB1, thus causing the Converter to shutdown.

6.18 DC output voltage is applied across resistor R4 and potentiometer R1, which is adjusted for a low voltage alarm level. When the output voltage decreases, the reference voltage developed across zener diode CR3 will remain stable, thus this difference between the voltage across potentiometer R1 and zener diode CR3 will be detected by comparator A1G2. Comparator A1G2 will swing positive causing light sensitive transistor Q4 to stop conducting, biasing transistors Q5 and Q6 off. Non-conduction of transistor Q6 will cause relay K1 to de-energize. Contacts of relay K1, de-energized, will provide two closed loop circuits and supply ground at two terminals for activation of external alarms, if connected.

LORAIN PRODUCTS
A RELIANCE ELECTRIC COMPANY
1122 F STREET LORAIN, OHIO 44052 216/288-1122
TWX 810-426-2130 (LORAIN PROD)
TLX 98-0505 (LORN PROD LORN)

ALSO WITH MANUFACTURING FACILITIES IN . . . . . .

CANADA

LORAIN PRODUCTS LTD.
122 EDWARD STREET
ST. THOMAS, ONTARIO
TEL: 519-631-0780
TWX: 610-356-6703 (LORAINPRODCAN)

MEXICO

PRODUCTOS LORAIN de MEXICO S.A. de C.V.
APARTADO POSTAL 77001
MEXICO 10, D.F., MEXICO
TEL: 576-62-77
TLX: 01774308 (1774308 LORME)

RECOMMENDED SPARE PARTS LIST
LORAIN MODEL HSB16A DC TO DC CONVERTER
SPEC. NO. 5635-007

This Recommended Spare Parts List is arranged alphabetically by part name. Spare parts are not usually required if adequate standby equipment is available and if the LORAIN equipment is installed at an accessible location so that parts can readily be obtained from Lorain Products stock. When ordering parts, please furnish equipment Model No., Spec. No., and Serial No. as given on the equipment nameplate.

LPC Part Number	Description	Quantity Recm. Spares Minimum Level	On-Site Level	Depot Level
ACCESSORIES				
2635-682	16.2K Ohm 1 Watt Resistor, Fixed	-	1	1
2635-711	75K Ohm 1 Watt Resistor, Fixed	-	1	1
ASSEMBLIES				
4257-022	LED Circuit Board	-	1	1
4337-325	Power Amplifier PW Board	-	1	1
4338-390	Driver PW Board	-	1	1
4863-760	High Volt Shutdown/Low Volt Alarm PW	-	1	1
4865-646	Voltage/Current Regulator PW Board	-	1	1
CAPACITORS				
2713-173	1UF 100 Volt DC	-	1	1
2724-106	0.1UF 500 Volt DC	-	1	1
2724-140	0.01UF 1000 Volt DC	-	1	1
2724-149	2700PF 1000 Volt DC	-	1	1
2724-181	0.022UF 1000 Volt DC	-	1	1
2731-106	10UF 100 Volt, Electrolytic	-	-	-
2731-270	2500UF 75 Volt, Electrolytic	-	-	-
2731-325	8.5KUF 75 Volt, Electrolytic	-	-	-
2737-137	10UF 35 Volt, Electrolytic	-	-	-
CIRCUIT BREAKERS				
2566-114	25 Amp 32 Volt DC	-	1	1
FUSES				
2483-438	20 Amp, Cartridge	3	3	3

RECOMMENDED SPARE PARTS LIST
LORAIN MODEL HSB16A DC TO DC CONVERTER
SPEC. NO. 5635-007

LPC Part Number	Description	Quantity Recm. Spares Minimum Level	On-Site Level	Depot Level
MAGNETIC UNITS				
4411-597	Inductor, DC Filter	-	-	1
4412-045	Inductor, DC Filter	-	-	1
4422-527	Current Transformer	-	-	1
4481-017	Power Transformer	-	-	1
METERS				
2923-447	0-25 Ammeter, DC	-	-	1
2943-419	0-30 Voltmeter, DC	-	-	1
RESISTORS				
2615-327	470K Ohm 1/2 Watt, Fixed	-	1	1
2615-351	4.7M Ohm 1/2 Watt, Fixed	-	1	1
2635-534	130 Ohm 1 Watt, Fixed	-	1	1
2635-665	6.81K Ohm 1 Watt, Fixed	-	1	1
2635-703	51.1K Ohm 1 Watt, Fixed	-	1	1
2651-466	6.2 Ohm 6.5 Watt, Fixed	-	1	1
2651-866	270 Ohm 5 Watt, Fixed	-	1	1
SEMICONDUCTORS				
2812-522	1N5402, Silicon Diode	-	2	2
2813-531	30 Amp 200 Volt Diode	-	2	2
2822-055	30 Amp 400 Volt DC Rectifier	-	2	2

RECOMMENDED SPARE PARTS LIST
LORAIN MODEL HSB16A DC TO DC CONVERTER
SPEC. NO. 5635-007

Part Number	Description	Quantity Recm. Spares Minimum Level	On-Site Level	Depot Level
MISCELLANEOUS				
2488-141	Fuseholder	-	-	1

LORAIN PRODUCTS
A RELIANCE ELECTRIC COMPANY

1122 F STREET LORAIN, OHIO 44052 216/288-1122
TWX 810-426-2130 (LORAIN PROD)
TLX 98-0505 (LORN PROD LORN)

ALSO WITH MANUFACTURING FACILITIES IN . . . . . .

CANADA

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APARTADO POSTAL 77001
MEXICO 10, D.F., MEXICO
TEL: 576-82-77
TLX: 01774308 (1774308 LORME)

CIRCUIT NOTES

101 FUSES SHOWN IN THIS TABLE ARE NOT PART OF EQUIPMENT

DESIG	FUSE AMP	POTENTIAL	ONE PER
BATTERY AND POWER SUPPLIES SYMBOLS		VOLTAGE RANGE	
		40-60	

102 UNLESS OTHERWISE SPECIFIED THE FOLLOWING OPTION IS PROVIDED. Z

OPTION	REFERENCES	
	WIRING	CONNECT TB2 JUMPERS
POS OUTPUT	Y	5 TO 9, 6 TO 8, 7 TO 10
NOMINAL 26.5V OUTPUT	X	
NEG OUTPUT	Z	5 TO 7, 6 TO 10, 8 TO 9

103 OPTIONAL FRAME GROUND FOR PROTECTION AGAINST REVERSE BATTERY POLARITY MAY BE REMOVED AFTER INSTALLATION

EQUIPMENT NOTES

201 REFER TO PD-5635-007 FOR EXTERNAL CONNECTIONS FUSING AND WIRE SIZE

INFORMATION NOTES

301 UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE MICROFARADS, AND VALUES PRECEDED BY THE SYMBOL + (PLUS) OR — (MINUS) ARE IN VOLTS

302 CODES WITHIN PARENTHESES, AS (4863-760) REPRESENT LPC PART NUMBERS

303 SEE WIRING DIAGRAM, T-5635-007 FOR LPC PART NUMBERS OF COMPONENTS

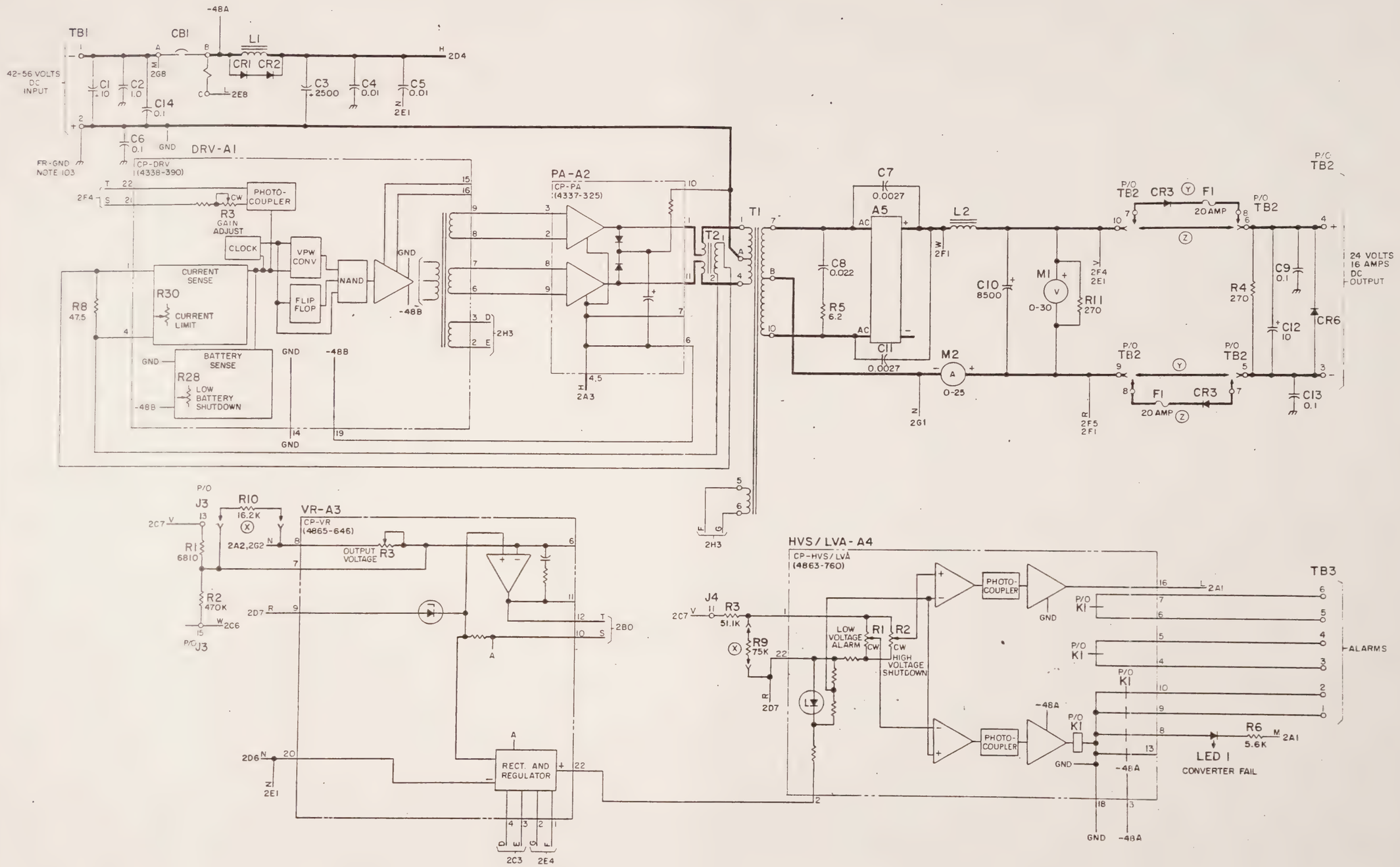
304 HIGHEST REF DESIG USED ON THIS DRAWING

RES	XMFR	DIODES	ASSYS	FUSES	CAP
R11	T2	CR6	A5	F1	C14
NOT USED					
R7		CR4,5			

REVISIONS

LTR	CHG BY / DATE	DESCRIPTION
		NEW
2	1835633 9	POLARITY OPTION 24 REVISED 75 G SOBOTKA 9-30-75
3	1835779	T2 AND R8 ADDED G SOBOTKA 12-8-75
4	1836047 4 15 76	(X) OPTION ADDED
5	1836092 5 17 76	R11 ADDED G SOBOTKA 4-14-76
6	1836438 11/8/77	(-) NEGATIVE TERM. ADDED TO A5 G SOBOTKA 12-15-77
7	183-7001 4-24-79	S.M.G REMOVED R7; A1 WAS 4338-281; A3 WAS 4865-611; REMOVED WIRE P FROM M2 & A3 G Sobotka 2-14-79
8	1837205 5-20-80	T.I. A1 WAS 4338-365 G.V Schmitz 5-20-80 N. Kammiller 5-20-80

181-1147	DESIGN N KAMMILLER ISS E
FUNCTIONAL SCHEMATIC FOR DC-DC CONVERTER MODEL HSB16A	DRAWN BY V. Baker DATE 10-10-75; CHECKED BY DATE 6-10-75; CHECKED BY N. KAMMILLER DATE 9-26-77; APPROVED BY DATE 9.8.77
LORAIN PRODUCTS CORPORATION LORAIN, OHIO LORAIN PRODUCTS (CANADA) LTD., ST THOMAS, ONTARIO	DWG SIZE D
	SD-5635-007
	SHEET 1 OF 2



MODEL HSB16A	SD-5635-007
LORAIN PRODUCTS CORPORATION — DWG SIZE D	SHEET 2 — PRINTED IN U.S.A.

ISSUE E

CPS-PA

(POWER AMPLIFIER)

COMPONENT LIST

CAPACITORS

DESIG	CODE
(2) C1, C3	(2724-181) 0.022 UF, 1000V DC
C2	(2731-607) 20 UF, 150V DC, ELECT.

DIODES

DESIG	CODE
(2) CR1, CR2	(2812-220)

RESISTORS

DESIG	CODE
(2) R1, R3	(2651-466) 6.2 OHM, 6 1/2 W, 5%
R2	(2652-488) 1K, 1W, 5%
R16	(2651-105) 1.5 OHM, 3 W, 5%

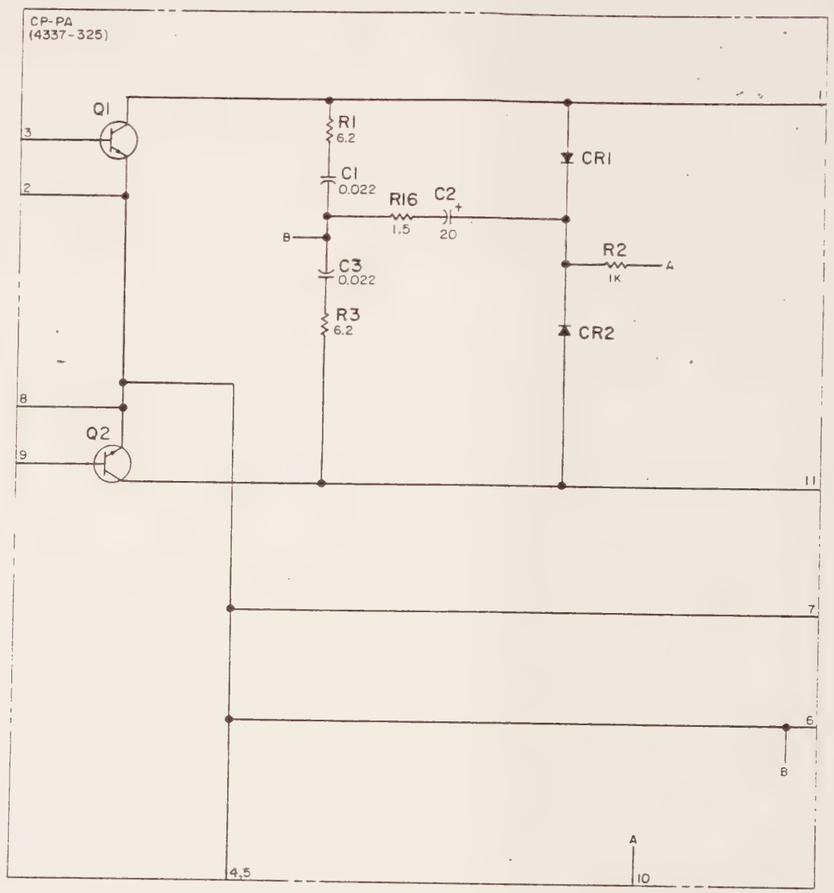
TRANSISTORS

DESIG	CODE
(2) Q1, 2	(2842-170)

INPUT/OUTPUT INFORMATION

CIRCUIT DESCRIPTION

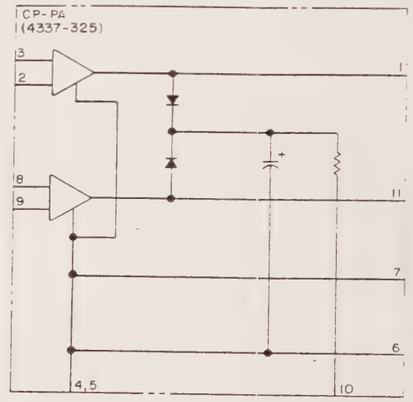
Q1 - Q2 OPERATE IN THE SWITCHING MODE AMPLIFYING A QUASI SQUARE WAVE SIGNAL APPEARING AT 2-3, 8 - 9. R1-R3, C1-C3, CR1, CR2 LIMIT VOLTAGE PEAKS ON Q1-Q2 COLLECTORS



MANUFACTURING REFERENCES

CATEGORY	NUMBER
ASSEMBLY DRAWING	4337-325
CONNECTOR ON FRAME	

SYMBOL



NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS AND CAPACITANCE VALUES ARE IN MICROFARADS; VALUES PRECEDED BY THE SYMBOL + (PLUS), OR - (MINUS), ARE IN VOLTS.
2. CODES WITHIN PARENTHESES, AS (2724-181), REPRESENT LPC PART NUMBERS.

REVISIONS

REV NO.	CHG'D BY CHG NOTICE NO.	DATE	DESCRIPTION
1	M		NEW
2	1835708 L.D.	10-23-75	R16 ADDED
3	1835779 M.R.J.	12-3-75	R4-R9 REMOVED

1811081

POWER AMPLIFIER ASSEMBLY

DESIGN'D BY	N.KAMMILLER	DATE
DRAWN BY	J REESE	6-18-75
CHECKED BY		6-18-75
CHECKED BY	N.KAMMILLER	8-27-75
APPROVED BY	H.L.C.D.	9-2-75
RATING	STANDARD	

LORAIN PRODUCTS CORPORATION
LORAIN, OHIO
LORAIN PRODUCTS (CANADA) LTD., ST. THOMAS, ONTARIO

DWG SIZE: D

SD-4337-325

SHEET 1 OF 1

PRINTED IN U.S.A.

COMPONENT LIST

CAPACITORS

DESIG	CODE
(2) C1,4	(2724-148) 3300PF, 1000V DC
C2	(2731-129) 50UF, 25V DC, ELECT.
C3	(2724-146) 680PF, 1000V DC
(2) C5,12	(2713-118) 0.01UF, 100V DC
C6	(2737-103) 0.1UF, 35V DC, TANTALUM
(2) C7,8	(2713-205) 0.0022UF, 200V DC
(2) C9,10	(2724-090) 0.1UF, 100V DC
C11	(2731-115) 30UF, 60V DC, ELECT
(2) C13,15	(2737-141) 47UF, 20V DC, TANTALUM
C14	(2724-140) 0.01UF, CERAMIC
C16	(2713-221) 0.022UF, 200VDC

DIODE

DESIG	CODE
(11) CR1,2,3,4,5,6,7,8, 15,18,19	(2811-101)
(6) CR9,10,20,21,22,23	(2812-220)
(3) CR12,13,14	(2835-510)
CR16	(2812-201)
CR17	(2835-411)
CR24	(2834-525)

INTEGRATED CIRCUITS

DESIG	CODE
A1	(2871-004) DUAL TIMER
A2	(2876-101) DUAL FLIP-FLOP
A3	(2876-302) TRIPLE NAND
A4	(2876-401) QUAD BUFFER
A5	(4337-040) CURRENT LIMIT ASSY

RESISTORS

DESIG	CODE
R1	(2662-408) 5.1 OHM, 2W, 5%
R2	(2615-257) 560 OHM, 1/2W
R3	(2675-117) 5K, 1/2W
R4	(2651-305) 3 OHM, 3W
R5	(2635-678) 12.7K, 1W, 1%
(4) R6,11,18,27	(2615-255) 470 OHM, 1/2W
(2) R7,17	(2651-339) 1.5K, 3W, 5%
(3) R8,16,22	(2615-271) 2.2K, 1/2W
(2) R9,14	(2615-291) 15K, 1/2W
(2) R10,13	(2615-263) 1K, 1/2W
R12	(2635-717) 100K, 1W, 1%
R15	(2635-636) 1.58K, 1W, 1%
R19	(2634-623) 3.32K, 1/4W, 1%
R20	(2651-550) 1.5K, 6-1/2W, 5%
R21	(2634-632) 4.75K, 1/4W, 1%
R23	(2615-235) 2.7 OHM, 1/2W
R24	(2615-333) 47K, 1/2W
R25	(2615-295) 22K, 1/2W
R26	(2635-647) 2.94K, 1W, 1%
R28	(2675-113) 1K, 1/2W
R29	(2634-648) 10K, 1/4W, 1%
R30	(2675-114) 2K, 1/2W
R31	(2634-605) 1.5K, 1/4W, 1%
R32	(2634-682) 51.1K, 1/4W, 1%

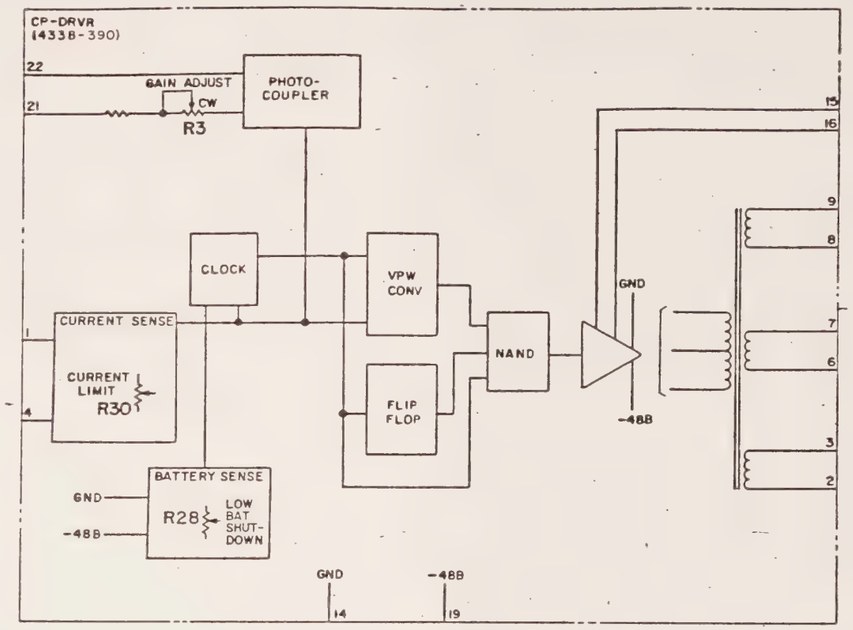
TRANSFORMERS

DESIG	CODE
T1	(4481-015)

TRANSISTORS

DESIG	CODE
Q1	(2857-101) PHOTO COUPLER
(2) Q2,5	(2844-010) PNP
(5) Q3,4,6,7,8	(2841-155) NPN
(2) Q9,10	(2841-100) NPN

SYMBOL



MANUFACTURING REFERENCES

CATEGORY	NUMBER
ASSEMBLY DRAWING	4338-390)
P.W. BOARD	3157-193
CONNECTOR ON FRAME	2475-772

NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS AND CAPACITANCE VALUES ARE IN MICROFARADS; VALUES PRECEDED BY THE SYMBOL + (PLUS), OR — (MINUS), ARE IN VOLTS.
2. CODES WITHIN PARENTHESES, AS (2662-408) REPRESENT LPC PART NUMBERS.

CIRCUIT DESCRIPTION

A1 CLOCK GENERATES 40 KHZ PULSE WHICH STARTS RAMP GENERATED IN A1 VOLTAGE/PULSE WIDTH CONVERTER. RAMP SLOPE OF VPW CONV. IS DETERMINED BY CURRENT THRU R12 PROPORTIONAL TO BATTERY VOLTAGE. PULSE WIDTH OUT OF VPW CONV. IS DETERMINED BY RAMP SLOPE AND CONDUCTION OF Q1, WHICH IS CONTROLLED BY REGULATOR CKT AND Q6, WHICH IS CONTROLLED BY INSTANTANEOUS COLLECTOR CURRENT IN POWER AMPLIFIER. A2 FLIP FLOP GENERATES 20 KHZ SQUARE WAVE FROM CLOCK PULSE. CLOCK PULSE, VPW CONV OUTPUT AND SQUARE WAVE ARE COMBINED IN A3 NAND GATE TO FORM TWO OUT OF PHASE WIDTH VARIABLE QUASI SQUARE WAVES AND THEIR COMPLEMENT WHICH ARE BUFFERED BY A4. THE QUASI SQUARE WAVES ARE AMPLIFIED BY Q2, Q3, Q4, Q5 OPERATING IN THE CONSTANT CURRENT MODE. THE COMPLEMENT IS AMPLIFIED BY Q7, Q8 OPERATING AS A CLAMP ON T1 TRANSFORMER PRIMARY. CR12-CR14 DEVELOP BIAS FOR AMPLIFIER TRANSISTORS AND SUPPLY VOLTAGE FOR A1-A4 CIRCUITS. WINDINGS 1,2 AND 3,4 PRODUCE BASE DRIVE VOLTAGE. WINDING 9,10 DEVELOPES POWER TO OPERATE REGULATOR AND ALARM CIRCUITS.

R26, R28 FORM A VOLTAGE DIVIDER ACROSS BATTERY THE OUTPUT OF WHICH IS COMPARED WITH REFERENCE CR17 TO CONTROL Q10 AND Q9. Q9 MAINTAINS C13 AT A LOW VOLTAGE UNTIL BATTERY IS SUFFICIENTLY HIGH TO ALLOW STARTING AT WHICH TIME C13 CHARGES ALLOWING VPW CONV. TO INCREASE PULSE WIDTH. CR20-CR23 RECTIFY OUTPUT OF EXTERNAL CURRENT TRANSFORMER LOCATED IN POWER AMPLIFIER CIRCUIT AND PEAK CHARGE C6. WHEN C6 VOLTAGE EXCEEDS REFERENCE CR1-A5, Q6 CONDUCTS REDUCING CONDUCTION ANGLE THRU CR18 AND CLOCK FREQUENCY THRU CR19 AND R19.

REVISIONS

1	NEW	REF. 4338-365	BP MAY 2
2	183 7357	3-20-81	D.A.C.
	C9 & C10 WERE 2724-106		

183-7205	DESIGN G. SCHMITZ	ISS. 2	
DRIVER	DRAWN BY J TUTTLE	DATE 5-20-80	
	CHECKED BY	DATE	
	CHECKED BY	DATE 5-20-80	
	APPROVED BY	DATE 5-20-80	
	RATING STANDARD		
LORAIN PRODUCTS CORPORATION LORAIN, OHIO	SIZE D	SD-4338-390	
		SHEET 1 OF 2	

PRINTED IN U.S.A.

CPS-DRVR

(DRIVER)

CP-DRVR
(4338-390)

C12 0.01 · R2 560 · GAIN ADJ 5K R3 CW · C15 47

Q1

R5 12.7K · R6 470 · R12 100K · P/O A1 · P/O A1 · A2

+C2 50 · R15 1.56K

CR4 CR5 CR6 CR7 CR8 CR15

C3 680 PF

CR24 · R19 3.32K

A3 G2 · A4 G1 · A3 G1 · A4 G2 · A3 G3 · A4 G3

R1 5.1 · R4 3 · T1

R8 2.2K · Q3 · R7 1.5K · Q2 · R9 15K · R10 1K · CR1 · R11 470

CR2 · R13 1K · CR3 · C1 3300PF

R14 15K · R16 2.2K · Q4 · R17 1.5K · Q5 · R18 470 · C4 3300PF

CR9 · CR10

R20 1.5K · Q7 · R22 2.2K · Q8 · CR12

CR13 · CR14

CP-CL (4337-0401) SPLY COM

CR19 · R21 475K · R24 47K · R25 22K

CR16 · Q9 · Q10 · CR17 LOW BAT SHUT-DOWN · R28 1K CW · R27 470 · R26 2.94K

C11 30 · R23 2.7

CR20 · CR23 · CR21 · CR22

C16 0.022 · C7 0.0022 · C5 0.01 · C6 0.1 · C8 0.0022 · C9 0.1 · C10 0.1

R29 10K · CR18 · R30 2K CW CURRENT LIMIT · R32 51 1K · Q6 · R31 1.5K

C14 .01 · C13 47

DRAWING ISSUE 1 J T 52080 · 2 M D.A.C. 3-20-81

ISSUE 2

DRIVER | SD-4338-390

LORAIN PRODUCTS CORPORATION | DWG SIZE D | SHEET 2 | PRINTED IN U.S.A.

CPS-VR

(VOLTAGE REGULATOR)

COMPONENT LIST

CAPACITORS

DESIG	CODE
C1	(2724-090) 0.1UF. 100V DC
C2	(2713-132) 0.1UF. 100V DC
C3	(2724-140) 0.01UF. 1000V DC
C4	(2731-105) 10UF. 50V DC. ELECT
C8	(2731-225) 1100UF. 40V DC. ELECT
C9	(2724-125) 220PF. 500V DC

DIODES

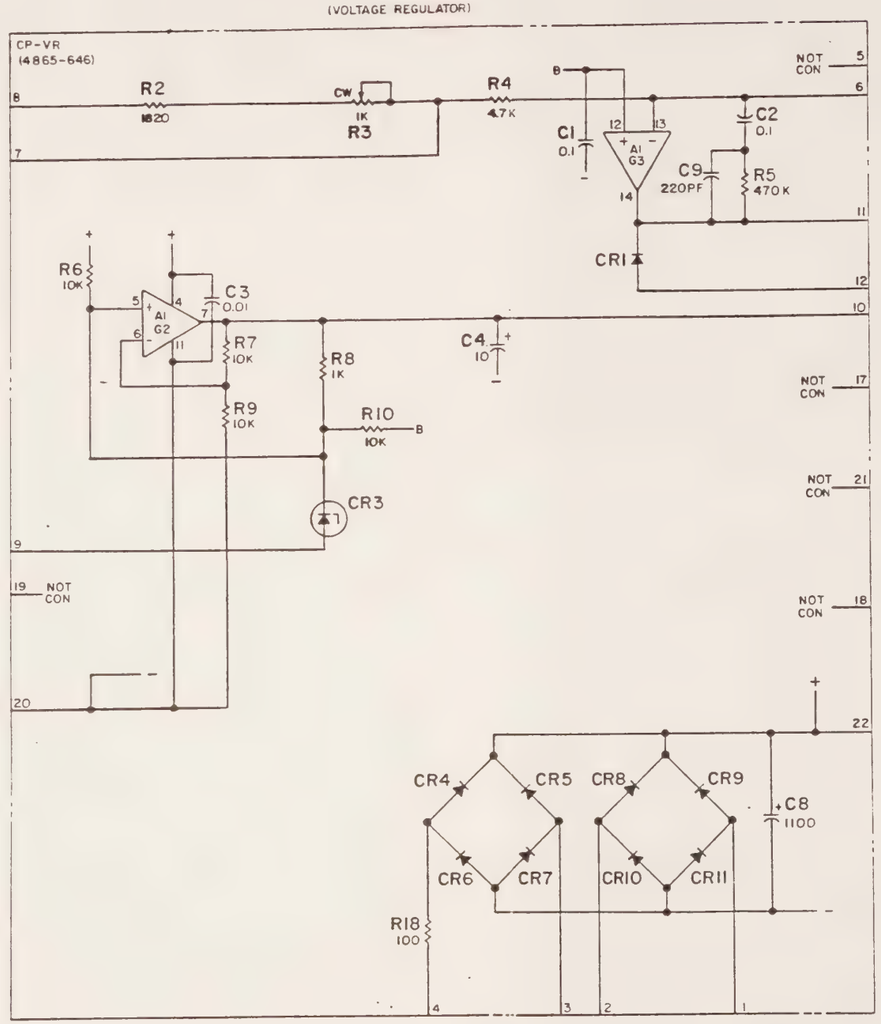
	DESIG	CODE
(5)	CR1,4,5,6,7 CR3	(2811-101) (2835-325) 6.2V. 0.4W ZENER
(4)	CR8,9,10,11	(2812-220)

INTEGRATED CIRCUITS

DESIG	CODE
A1	(2871-115)

RESISTORS

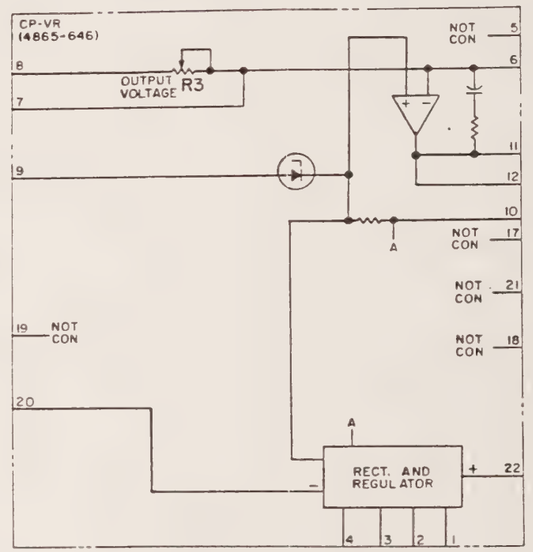
	DESIG	CODE
	R2	(2635-637) 1820 OHM 1W 1%
	R3	(2675-113) 1K. 1/2W. POT
	R4	(2615-279) 4.7K. 1/2W
	R5	(2615-327) 470K. 1/2W
(3)	R6,7,9	(2615-287) 10K. 1/2W
	R8	(2635-624) 1K. 1W. 1%
	R10	(2635-673) 10K. 1W. 1%
	R18	(2615-239) 100 OHM 1/2W



MANUFACTURING REFERENCES

CATEGORY	NUMBER
ASSEMBLY DRAWING	4865-646
P.W. BOARD	3158-510
CONNECTOR ON FRAME	2475-776

SYMBOL



NOTES:

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2. CODES WITHIN PARENTHESES, AS (2713-142), REPRESENT LPC PART NUMBERS.

CIRCUIT DESCRIPTION

A1G1 COMPARES SIGNAL DEVELOPED ACROSS R2, R3 PROPORTIONAL TO OUTPUT VOLTAGE WITH REFERENCE DEVELOPED ACROSS CR3. COMPARATOR OUTPUT CONNECTED BY DIODE CR1. DIODE OUTPUT DRIVES OFF BOARD PHOTO ISOLATOR. A1G3 FUNCTIONS AS A SERIES REGULATOR FOR ISOLATED SUPPLY VOLTAGE DEVELOPED ACROSS C5 AND SUPPLIES PHOTO ISOLATOR AND CR3 REFERENCE. CR4-CR11 COMPRISES ALTERNATE RECTIFIERS FOR 20K HZ POWER FROM DRIVER AND OUTPUT CIRCUITS.

REVISIONS

LTR	ECN	BY	DATE	DESCRIPTION
I	NEW	REF 4865-6N		
2	M 1837357		3-18-81	CI WAS 2724-106 MAY 23 1980

1837001

VOLTAGE REGULATOR

DESIGN	G. SCHMITZ
DRAWN BY	JJJ
DATE	3-12-79
CHECKED BY	
DATE	
CHECKED BY	G. Schmitz
DATE	3-13-79
APPROVED BY	(Smith Paradise)
DATE	3/22/79
RATING	
ISS	2

LORAIN PRODUCTS CORPORATION
LORAIN, OHIO

DWG SIZE D

SD-4865-646

SHEET 1 OF 1

CPS-HVS/LVA

(HIGH VOLTAGE SHUTDOWN - LOW VOLTAGE ALARM)

COMPONENT LIST

CAPACITOR

DESIG	CODE
C1	(2713-132) 0.1 UF, 100 VDC
C2	(2731-103) 10 UF, 100 VDC, ELECT.
C3	(2724-140) 0.01UF. 1000 VDC

DIODES

DESIG	CODE
(2) CR1,2	(2812-223)
CR3	(2835-325) 6.2V, 400MW, ZENER

INTEGRATED CIRCUITS

DESIG	CODE
A1	(2871-115) QUAD OP-AMP

RELAYS

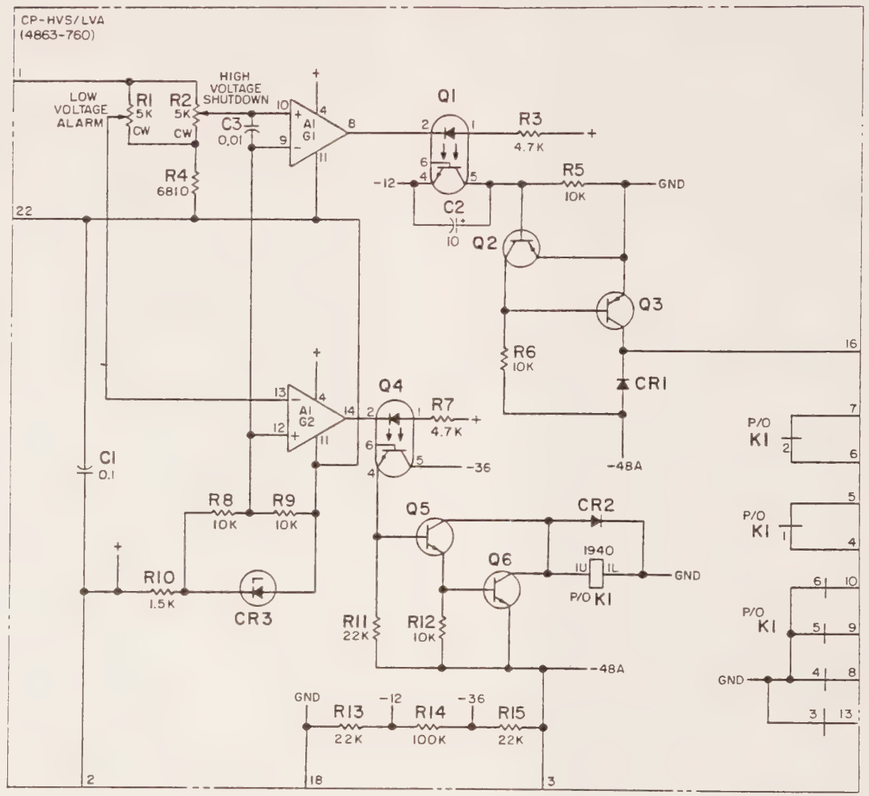
DESIG	CODE
K1	(2543-443) 1940 OHM, 62V, COIL

RESISTORS

DESIG	CODE
(2) R1,2	(2675-117) 5K, 1/2W, POT.
(2) R3,7	(2615-279) 4.7K, 1/2W
R4	(2635-665) 6810 OHM, 1 W, 1%
(2) R5,12	(2615-287) 10K, 1/2W
R6	(2615-487) 10K, 1W
(2) R8,9	(2635-673) 10K, 1W, 1%
R10	(2615-267) 1.5K, 1/2W,
(3) R11,13,15	(2615-295) 22K, 1/2W
R14	(2615-311) 100K, 1/2W

TRANSISTORS

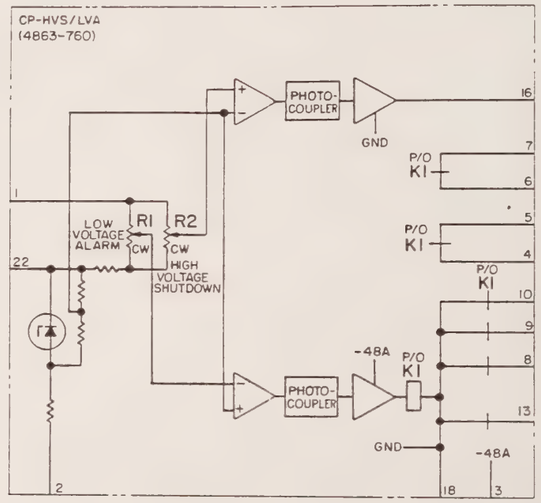
DESIG	CODE
(2) Q1,4	(2857-101) PHOTO-COUPLER
Q2	(2843-151) PNP
Q3	(2843-041) PNP
(2) Q5,6	(2841-102) NPN



MANUFACTURING REFERENCES

CATEGORY	NUMBER
ASSEMBLY DRAWING	4863-760
CONNECTOR ON FRAME	2475-772

SYMBOL



INPUT/OUTPUT INFORMATION

CIRCUIT DESCRIPTION

A PORTION OF OUTPUT VOLTAGE IS DEVELOPED ACROSS R1, R2, R4. IT IS COMPARED WITH REFERENCE DEVELOPED ACROSS CR3 AT A1, G1 AND G2. A1, G1 OUTPUT IS ISOLATED BY Q1 AND AMPLIFIED BY Q2, Q3 TO ENERGIZE COIL OF VOLTAGE TRIP INPUT CIRCUIT BREAKER ON OVERVOLTAGE CONDITION. A1, G2 OUTPUT IS ISOLATED BY Q4 AND AMPLIFIED BY Q5, Q6 TO ENERGIZE K1 LOW VOLTAGE ALARM RELAY

NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS AND CAPACITANCE VALUES ARE IN MICROFARADS; VALUES PRECEDED BY THE SYMBOL + (PLUS), OR — (MINUS), ARE IN VOLTS.
2. CODES WITHIN PARENTHESES AS (2713-132), REPRESENT LPC PART NUMBERS.

REVISIONS

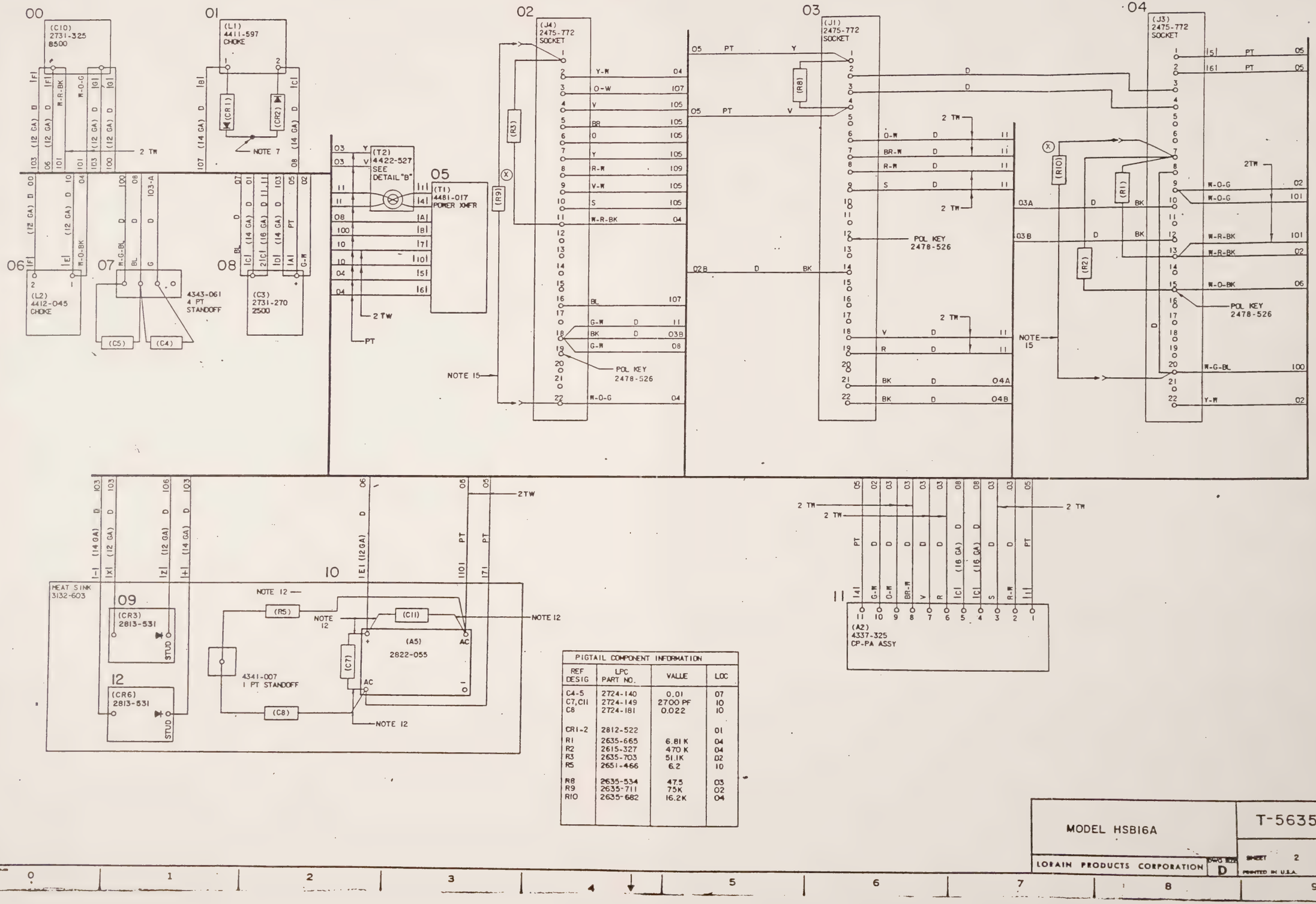
ISS NO.	ORIG. BY / CHK. & APP. NO.	DATE	DESCRIPTION
1 M			NEW
2 M	1835633 9 / 23 / 75		CONTACT SET ADDED. G. SOBOTKA 9-26-75
3 M	1835779 12 / 2 / 75		"A" DESIGNATION ADDED TO BATTERY SYMBOL G. SOBOTKA 10-2-75
4 M	1835984 3 / 15 / 76		C3 ADDED. CONNECTOR WAS 2475-776 G. Sobotka 2-25-76

181-1152	DESIGN N KAMMILLER	ISS. 4
HIGH VOLTAGE SHUTDOWN-LOW VOLTAGE ALARM	DRAWN BY J Baer 4-21-75; CHECKED BY 4-21-75; CHECKED BY K.M. KAMMILLER 4-24-75; APPROVED BY 4-8-75; RATING	
LORAIN PRODUCTS CORPORATION, LORAIN, OHIO (LORAIN PRODUCTS (CANADA) LTD., ST. THOMAS, ONTARIO)	DWG SIZE D	SD-4863-760
		SHEET 1 OF 1

PRINTED IN U.S.A.

| SD-DRAWING ISSUES AND T-DRAWING ISSUES AS FOLLOWS: | | |

FIG. 3
BASE



PIGTAIL COMPONENT INFORMATION			
REF DESIG	LPC PART NO.	VALUE	LOC
C4-5	2724-140	0.01	07
C7, C11	2724-149	2700 PF	10
C8	2724-181	0.022	10
CR1-2	2812-522		01
R1	2635-665	6.81K	04
R2	2615-327	470K	04
R3	2635-703	51.1K	02
R5	2651-466	6.2	10
R8	2635-534	47.5	03
R9	2635-711	75K	02
R10	2635-682	16.2K	04

MODEL HSB16A	T-5635-007
LORAIN PRODUCTS CORPORATION DWG SIZE D	SHEET 2
	PRINTED IN U.S.A.

FOR PARTS OR SERVICE, CONTACT THE NEAREST

LORAIN REGIONAL SERVICE CENTER

OHIO REGIONAL SERVICE CENTER
1313 G Street
Lorain, Ohio 44052
Telephone: 216/288-1122

TEXAS REGIONAL SERVICE CENTER
722 N. Great Southwest Parkway
Arlington, Texas 76011
Telephone: 817/640-1134

CONNECTICUT REGIONAL SERVICE CENTER
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East Windsor, Connecticut 06088
Telephone: 203/627-9378

SOUTHERN CALIFORNIA REGIONAL SERVICE CENTER
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Costa Mesa, California 92626
Telephone: 714/540-4395

ILLINOIS REGIONAL SERVICE CENTER
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West Chicago, Illinois 60185
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San Jose, California 95131
Telephone: 408/263-1303

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Norcross, Georgia 30093
Telephone: 404/449-0840

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122 Edward Street
St. Thomas, Ontario
Telephone: 519/631-0780

COLORADO REGIONAL SERVICE CENTER
4010 Youngfield St.
Wheat Ridge, Colorado 80033
Telephone: 303/422-6213

LORAIN SERVICE® CAN ALSO PROVIDE:

Audio Visual Training Programs (Slide/Cassette)

- Battery Charger Maintenance - No. L302AV
- Storage Battery Maintenance - No. L301AV
- Central Office Ground Maintenance - No. L401AV

Factory or On-Site Training School

Specialized Test Equipment

- Ringing Generator Test Set - Model LS2000
  (Includes loads, metering, digital frequency counter)
- Ringing Demand Test Set - Model LS5000
  (measures ring load current and voltage)
- 130V Converter Test Load - Model LS1000
  (Variable loads to 6 amps)

Power Evaluation Program (PEP)

- Power analysis program for all central office power equipment including batteries.

Power Upgrade and Modernization Services

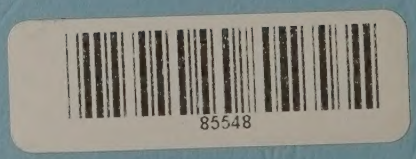
- Including engineering, fabrication and complete installation

Maintenance Contracts

Spare Parts Kits and Fuse Kits

Handy and practical, helps keep down time to a minimum.

Contact your nearest LORAIN Regional Service Center for more information.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